Original Article

Appropriateness of elective percutaneous coronary intervention and impact of government health insurance scheme — A tertiary centre experience from Western India

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ABSTRACT

Background: There is a dearth of data regarding the appropriateness of elective percutaneous coronary intervention (PCI) in a limited-resource country such as India. In an attempt to rationalise the use of PCI, Appropriate Use Criteria (AUC) were developed for cardiovascular care in the USA. In the Indian context, considering the high prevalence of coronary artery disease, the dramatic rise in the number of revascularization procedures and an increasing role of government/private reimbursements, application of AUC could potentially guide policy to optimize the utilization of resources and the benefit-risk ratio for individual patients.

Objectives: The study sought to determine the overall and year-wise trends in the appropriateness of elective PCI using the AUC and also understand the impact of the government health insurance scheme (GHIS).

Material and Methods: The inpatient records of all patients undergoing elective PCI, at a single large tertiary care centre in Western India, from January 2009 to December 2014 were retrospectively analysed (n=972, 759 males, 213 females) by a neutral observer. The AUC scores and subsequent ranking were calculated using the dedicated web-based software and each PCIwas ranked as either 'appropriate', 'uncertain' or 'inappropriate'. Elective PCI performed within a month after the index acute coronary syndrome (ACS) was considered as 'ACS' while applying the AUC. All other indications were considered as 'non-ACS'. Nearly 95% of elective PCI performed after July 2012 were covered under theGHIS and therefore the period January 2009–June 2012 was compared with the July 2012– December 2014 to assess the impact of this scheme.

Results: A total of 894 elective PCI (379 and 515 PCI in the ACS setting and non-ACS setting respectively) performed on 857 patients were analysed. The elective PCI performed in the pre-GHIS and GHIS period were 458 and 436 respectively. As per AUC, 352 (39.6 ± 4.4 %) of the overall elective PCI were ranked as 'appropriate', while 487 (55.3 ± 4.1 %) cases as 'uncertain' and 55 (5.1 ± 0.6 %) cases as 'inappropriate'. An overall year-wise temporal trend in the proportion of cases in any of the AUC rankings did not show any significant trends($p > 0.05$). However, 80.4 ± 7.3 % of elective PCI in the ACS setting were categorised as 'appropriate' and 82.6 ± 6.9 % of elective PCI in non-ACS setting were ranked as 'uncertain'. With state-wide implementation of the GHIS, the total number of elective PCI increased by 50% (436 in the $3^1/_2$ year pre-GHIS study period as against 458 in the $2^1/_2$ year GHIS study period). The introduction of GHIS led to a marginal increase ($p > 0.05$) in the average annual number of elective PCI in non-ACS setting as opposed to a 120% rise in the number of elective PCI done in the ACS setting ($p < 0.001$) and the delay in performing PCI after coronary angiogram reduced from 55.8 ± 43.6 days to 33 ± 22.9 days ($p < 0.01$). Also, the ratio of men: women undergoing elective PCI rationalised from 5.4:1 to 2.7:1 ($p < 0.001$). With the introduction of the GHIS, the share of 'inappropriate' elective PCI in the ACS setting increased from 1.34 % to 4.81 % ($p =0.065$). However, there was also a fall in 'appropriate' elective PCI in the non-ACS setting from 15.0 ± 3.2% to 7 ± 1.6% ($p < 0.001$).

Conclusion: On applying the 2012 updated AUC, about 5 % of overall elective PCI were deemed as 'inappropriate'. About four in every five elective PCI in the non-ACS setting were of 'uncertain'

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appropriateness. The implementation of the GHIS not only significantly reduced the gender bias and delay in seeking interventional coronary care but also led to a significant rise in the proportion of PCI performed in the ACS setting. However, there was also a rise in 'inappropriate' PCI in the ACS setting and a significant fall in 'appropriate' PCI in the non-ACS setting after introduction of the GHIS..

1. Introduction

Overuse of percutaneous coronary intervention (PCI) as a revascularization strategy is frequently alleged.[1,2] Based on the Indian national registry data, the annual number of PCI increased multi-fold from about 0.02 million in 2002 to 0.25 million by the year 2014.[3] The average cost of PCI with a single stent ranges from USD 1500–2500 (INR 75000–1,40,000).[4] The average annual per capita income of the Indian population is around USD 1550 (INR 85,000) making PCI a significant financial burden for the community.

Patients who undergo PCI are also exposed to the risks of peri-procedural complications, long term bleeding and stent thrombosis. Optimising medical management can achieve acceptable levels of symptomatic relief compared to revascularization strategies in patients with stable angina. Given the huge cost and invasiveness of PCI as opposed to the modest benefit it offers, determining the extent of usefulness of a PCI procedure may help improve utilisation of available resources. Patients and their families, payers as well as clinicians now seem to be interested in assessing whether and to what extent a particular coronary revascularization strategy would benefit the patient. Inappropriate revascularization may not only harm a patient but also incur avoidable costs to the healthcare providers.[5] With an increasing number of patients now being covered for their medical expenses, the appropriateness of a PCI is of paramount importance.

Considering all these aspects and in an effort to address the rational use of coronary revascularization, the American College of Cardiology Foundation (ACCF), in collaboration with the Society for Cardiovascular Angiography and Interventions (SCAI), the Society of Thoracic Surgeons (STS), the American Association for Thoracic Surgery (AATS) and other national societies, developed in 2009 and later updated in 2012, appropriate use criteria (AUC) for multiple (about 180) clinical scenarios wherein coronary revascularization could be used.

There is paucity of data regarding the appropriateness of coronary revascularization in western India. In this study, the AUC were applied to all patients undergoing elective PCI from January 2009 to December 2014 at one of the largest public-sector tertiary referral centres in the state of Maharashtra, India. The impact of the state-wide government health insurance scheme (GHIS), introduced from July 2012 onwards was assessed in terms of not only gender bias and the delay in seeking interventional care but also the proportional rise in cases performed in the acute coronary syndrome (ACS) setting and the trends in AUC ranking of elective PCI.

2. Technical aspects regarding the development of AUC[6]

Upon thorough review of available evidence and literature, an annotated summary regarding effectiveness as well as the risks of PCI and CABG for the various indications for revascularisation was prepared. Next, a set of clinical scenarios were derived that encompassed both appropriate and inappropriate care that would likely arise in clinical practice. The technical panel (a 17- member panel composed of 4 interventional cardiologists, 4 cardiovascular surgeons, 8 members representing non-interventional cardiologists, physicians who treat patients with cardiovascular disease, health outcome researchers and 1 medical officer from a health plan) then rated the appropriateness of each indication through a two-step modified Delphi exercise. Panellists were first asked individually, and then collectively, to assess the benefits and risks of a test or procedure in the context of the potential benefits to patients' outcomes with an implicit understanding of the associated resource use and costs. The major variables for determining appropriateness include severity of angina, extent of medical therapy, extent of ischemia and extent of anatomic disease. After the rating process, using an established rigorous methodology, the clinical scenarios were scored on a scale of 1–9. Scores of 7 to 9 indicate that revascularization be considered 'appropriate', while scores of 1–3 indicate that revascularization be considered 'inappropriate'. Scores in the mid-range (4–6) indicate uncertain appropriateness of coronary revascularization (Table 1).[6,7]

3. Material and methods

The inpatient records of all patients undergoing elective PCI from January 2009 to December 2014 at a single large tertiary care centre in Western India were retrospectively analysed by a neutral observer. Patients undergoing primary PCI, rescue PCI, PCI as part of a pharmacoinvasive strategy, PCI in the same admission as for the ACS and those with incomplete hospital records were excluded from the study. At this institute, elective PCI during the study period were performed in a single catheterization laboratory only once a week. The rest of the days were allotted for the large numbers of non-coronary procedures which include pediatric, valvular and electrophysiological interventions seldom performed elsewhere in the public health set up of the state. This accounts for the relatively small study population considering the long duration of the study. The majority of patients included in this study had single or double vessel disease. Considering the non-affordability of patients, as a part of institutional policy, triple vessel PCI was strongly discouraged. Also, as per the rules of Government of

Table 1
Categories of 2012 Appropriate Use Criteria (AUC).

Ranking	Score	Remark
Appropriate	7–9	procedure is generally acceptableand is a reasonable approach for the indication
Uncertain	4–6	procedure may be generally acceptable and may be a reasonable approach for the indication).Uncertainty implies that more research and/or patient information is needed to classify the indication definitively
Inappropriate	1–3	Procedure is not generally acceptable and is not a reasonable approach for the indication

Maharashtra, the treating physicians at this institute were receiving fixed compensation without any financial or non-financial incentives; thereby negating its accountability for rise in the number of PCI in recent years. The team of interventional cardiologist involved in therapeutic decision making and performance of PCI remained relatively fixed during the study period. The AUC score for each PCI included in the study was calculated using dedicated web-based software by manually computing appropriate patient details (www.scaiaucapp.org). Accordingly, each PCI was then ranked as either 'appropriate', 'uncertain' or 'inappropriate'. Elective PCI performed within four weeks of the acute event was considered as 'ACS' to assess the AUC. All other indications were considered as 'non-ACS'. The TIMI score of patients in the 'ACS' group was calculated based on the hospital records. The year-wise temporal trends in AUC ranking of elective PCI were analysed. A public health insurance scheme (GHIS) viz. the Rajiv Gandhi Jeevandayee Arogya Yojana (recently rechristened as the Mahatma Phule Jeevandayee Arogya Yojana) run in collaboration with the National Insurance Company and funded by the Department of Public Health, Government of Maharashtra, India covered almost all elective PCI performed after July 2012 at this institute. Accordingly, the entire study results can be divided into a pre-GHIS and GHISperiod to further understand the trends in AUC of elective PCI once the finances for the procedure were promptly

sanctioned under the GHIS. Sanction of funds for PCI under GHIS first requires pre-authorization using patient details, treating clinician's record mentioning the indication for PCI with the number of desired stents and clips of coronary angiogram. The post procedure processing requires submission of angiographic clips of various stages of PCI, operative notes and the details of stent used. During the study period, under the GHIS, apart from authorization denial for triple vessel PCI, there was no process to question the treating clinicians' decision regarding the indication of PCI.

4. Statistical analysis

Descriptive data were reported as mean $\pm$ SD or count (percent), as needed. The Shapiro-Wilk test was used to check the normality of the outcome distributions. The 'N-1' Chi-squared test and Fischer-Irwin test with small sample recommendations were used to assess the nominal data to compare various parameters of the pre-GHIS and GHIS period. Differences were considered statistically significant at $p \leq 0.05$.

5. Results

Amongst the 972 PCI performed during the study period, 78 cases (63 cases with incomplete records, 4 primary PCI, 11 PCI cases

Table 2
Baseline demographic characterstics of study population.

	2009 − June 30, 2012 (Pre GHIS period)	July 1 2012–2014 (GHIS period)	Total	P value
Total	435	459	894	
Duration	3 $^1/_2$ years	2 $^1/_2$ years	5 years	
Gender				
Male	367(84.4%)	335(72.9%)	702(78.5%)	<0.001
Female	68(15.6%)	124(27.1)	192(21.5%)	<0.001
Male: Female ratio	5.39	2.7	3.65	<0.001
Age (years)	55.26 ± 8.62	54.23 ± 9.42	54.5 ± 9.64	NS
Young patients (<40years)	32 (7.35%)	34 (7.40%)	66 (7.38%)	NS
Risk Factors				
Smoking	115 (26.43%)	129 (28.10%)	244 (27.28%)	NS
Diabetes	106 (24.37%)	130 (28.32%)	236 (26.39%)	NS
HTN	171 (39.31%)	192 (41.83%)	363 (40.51%)	NS
Family History	10 (2.29%)	14 (3.05%)	24 (2.68%)	NS
PCI Indication				
Stabilised ACS	150 (34.48%)	227 (49.45%)	377 (42.17%)	<0.001
Non acute	285 (65.5%)	232 (50.54%)	517 (57.83%)	<0.001
STEMI	112(74.67%)	170 (74.89%)	282(74.80%)	NS
NSTEMI	8(5.33%)	21((9.25%)	29(7.70%)	NS
UA	30(20%)	36(15.85%)	66(17.50%)	NS
CCS grades of Angina				
Asymptomatic	0	0	0	
Class I	12 (2.75%)	18 (3.92%)	30 (3.35%)	NS
Class II	336 (77.24%)	352 (76.69%)	688 (76.96%)	NS
Class III	87 (20.0%)	89 (19.39%)	176 (19.69%)	NS
Class IV	0	0	0	
Non-invasive ischemia test	42 (9.65%)	51 (11.11%)	93 (10.40%)	
Low risk findings	14 (33.34%)	19(37.25%)	33(35.48%)	NS
Intermediate risk findings	25 (59.52%)	27(52.94%)	52(55.92%)	NS
High risk findings	3 (7.14%)	5(9.80%)	8(8.94%)	NS
Medication				
No or minimal medication	156 (35.86%)	162 (35.30%)	318 (35.57%)	NS
Maximal medication	278 (63.90%)	297 (64.70%)	575 (64.31%)	NS
Stents				
Stents deployed (Total)	463	485	948	NS
Stents deployed per case	1.06	1.05	1.06	NS

wherein PCI was performed at index ACS admission) satisfied exclusion criteria and therefore 894 PCI performed on 857 patients were analysed. The baseline characteristics are represented in Table 2. On applying the updated AUC, overall 352 (39.6 ± 4.4%) cases studied were categorised as 'appropriate', 487 (55.3 ± 4.1%) as 'uncertain' and 55 (5.1 ± 0.6%) as 'inappropriate'. An overall year-wise temporal trend in the proportion of cases in any of the AUC rankings did not show any significant trends (p > 0.05). The distribution of 'appropriateness' varied significantly in the ACS group as compared to the non-ACS group. About 80.4 ± 7.3% of elective PCI in the ACS setting were categorised as 'appropriate' as against to only about 11% in the non-ACS setting. About 82.7 ± 7% of elective PCI in the non-ACS group were ranked as 'uncertain'. With statewide implementation of the GHIS, the total number of elective PCI increased by 50% (436 in the $3^{1}/_{2}$ year pre-GHIS study period as against 458 in the $2^{1}/_{2}$ year GHIS study period). An important trend noted during this period was a marginal increase in the average number of elective PCI in the non-ACS setting done annually (p > 0.05) as opposed to a 120% rise in the number of elective PCI done in the ACS setting (p < 0.001) (Fig. 1). The ratio of men: women undergoing elective PCI in our study population was 5.39:1 in the pre-GHIS period and rationalised to 2.7:1 in the GHIS period (p < 0.001). The share of 'inappropriate' elective PCI in the ACS group increased from 1.34% in the pre-GHIS period to 4.8% (p = 0.065) in the GHIS period. There was a fall in 'appropriate' elective PCI in the non-ACS setting from 15 ± 3.2% to 7 ± 1.6% after introduction of GHIS (p < 0.001) (Fig. 2).

5.1. Trends in delay in treatment

The delay in performing an elective PCI after CAG in the pre-GHIS period was 56 ± 43.5 days. However, the same in the GHIS period was streamlined to 33 ± 23 days (p < 0.01).

5.2. Major trends in 'uncertain' and 'inappropriate' group

About 87% PCI ranked as 'uncertain' were patients who underwent elective PCI (not involving the proximal LAD artery) for class II symptoms without any non-invasive ischemia test (NIIT). About 54.5% 'inappropriate' elective PCI patients had STEMI with late PCI performed on totally occluded infarct related vessels.

5.3. Trends in PCI on totally occluded vessels

About 11% (98 of 894) of all PCI were performed on totally occluded vessels. Thirty (30.6% of all PCI on totally occluded vessels) PCI involved totally occluded vessels after 12 h of STEMI and thereby added to the burden of the 'inappropriate' PCI list. About 61 elective PCI were performed on totally occluded vessels in the non-ACS group. About 39% of patients (24 of 61) in this subset involved revascularisation of a totally occluded proximal LAD artery. Revascularization of a totally occluded proximal LAD is usually considered appropriate in view of the large area of myocardium at jeopardy. All the remaining 37 patients (61% PCI on totally occluded vessels in non-ACS setting) were ranked as 'uncertain' appropriateness.

6. Discussion

The majority of patients seeking cardiology care at our centre belong to the middle and lower income groups. Inability to arrange finances for coronary revascularisation was therefore an important reason for delay in interventional therapy. However, after July 2012, almost all the patients admitted to our department were beneficiaries of the GHIS. This led to prompt sanction of finances and swift revascularization. With the proportion of females undergoing elective PCI rising, the GHIS has undoubtedly led to amelioration in the gender bias towards expensive therapy and thereby fostered social welfare. The delay in performing PCI has been almost halved by the introduction of GHIS. However, the institutional practice of staggering elective PCI by appointments, and introduction of GHIS in private institutions might be important confounding factors while interpreting the cut in delay.

6.1. Overall trends

Our findings are in partial congruence with the cathPCI registry data.[8] This is an important finding as this is the first application of AUC to cardiovascular care in Western India. Even though the results are encouraging, there continues to be a significant scope for improvement. The implications of 'uncertain' and 'inappropriate' PCI in low-income countries with scanty resources are understandably huge. The nationwide application of AUC for
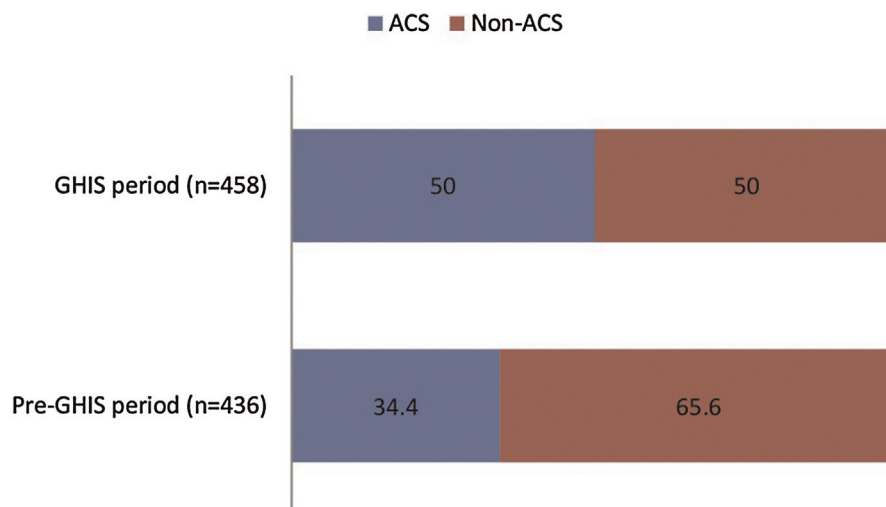

■ ACS ■ Non-ACS

GHIS period (n=458)	50	50
Pre-GHIS period (n=436)	34.4	65.6

Fig. 1. Distribution of indications of elective PCI cases in the $3^{1}/_{2}$ –year Pre-GHIS period as compared to the $2^{1}/_{2}$-year GHIS period expressed as percentage.
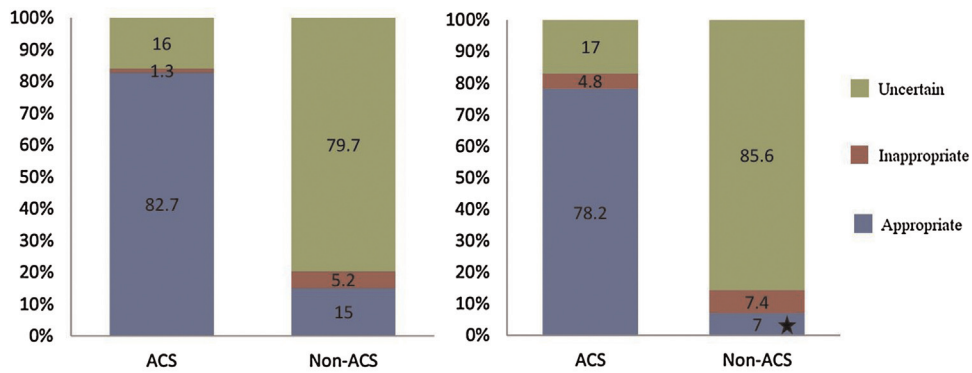
Fig. 2. Distribution of Appropriateness ranking in ACS and Non-ACS setting in the pre-GHIS (left) and GHIS period (right). (comparison with p value <0.05 marked with star).

elective PCI may further lead to efficient utilization of available resources.[9] The phenomenal rise in elective PCI in the ACS group as compared to the non-ACS reflects not only the contribution of GHIS but also an improved professional responsibility during case-selection for elective PCI in the non-ACS setting.

6.2. Trends in PCI with 'uncertain' appropriateness

The majority of patients who underwent PCI with 'uncertain' appropriateness belonged to the non-ACS group. About 87% of PCI ranked as 'uncertain' were patients who underwent elective PCI (not involving the proximal LAD artery) for class II symptoms without any NIIT. Their AUC score is 5 and covered under indication 20 as per the updated AUC. This subset of patients constitutes about 47% of all elective PCI. We therefore believe that NIIT to document ischemia before the planned elective PCI would have helped to better stratify the appropriateness as also noted by Aguilar et al. [10] The appropriateness score would then swing in either direction from 'inappropriate' range to 'appropriate' range

depending upon the test results. About 7% of overall PCI were done on patients with UA/NSTEMI with low (<2) TIMI scores. This group (indication 9 as per the 2012 updated AUC) comprises 12.5% of all PCI ranked as 'uncertain'. Patient with one/two – vessel disease (without involvement of the proximal LAD), intermediate risk on NIIT, class II symptoms and minimal anti-angina therapy compromised less than 1% of all PCI with "uncertain" appropriateness. It is important to note that apart from stress ECG, which is fraught with lower accuracy rates and practical difficulties in assessing the Duke treadmill score, other forms of NIIT are expensive and beyond the reach of many patients. However, an overdependence on clinical judgement of angina and a higher threshold to optimise anti-angina treatment prior to elective revascularization cannot be denied in our scenario.

6.3. Trends in the 'inappropriate' PCI group

The major subset (54.5%) of elective PCI ranked as 'inappropriate' comprised of patients with STEMI. These were PCI performed
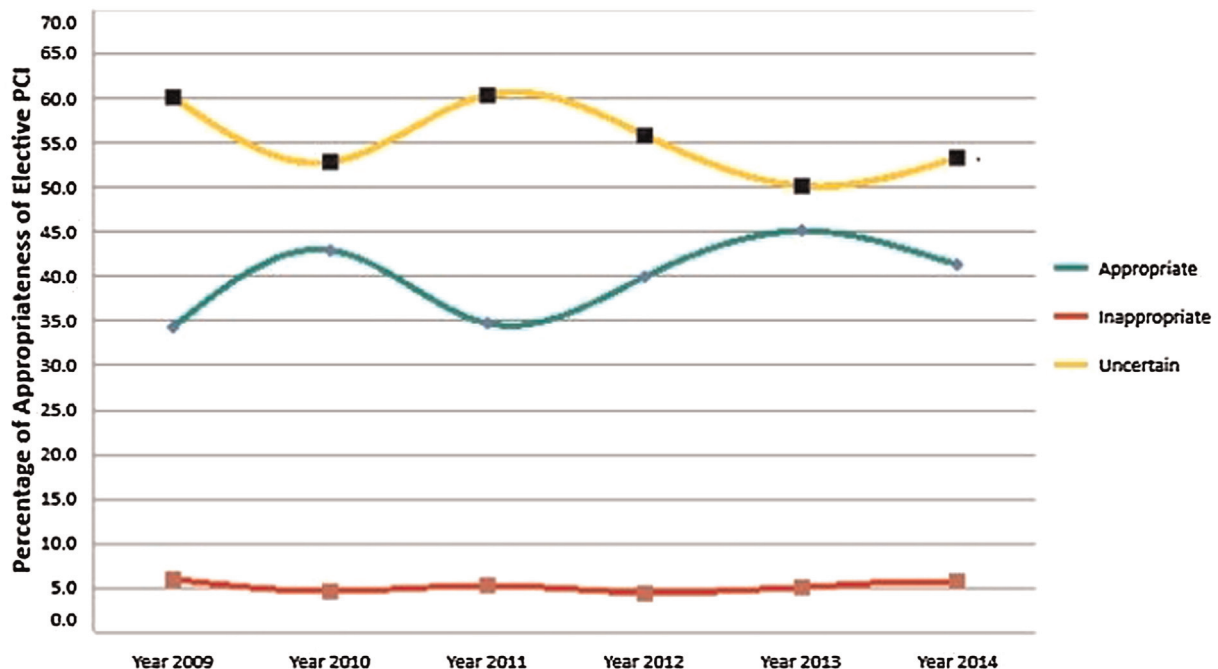

Fig. 3. Year-wise temporal trend in the 'Appropriateness' of elective PCI.

Table 3
Important Limitations of the AUC.

Important statements made by the Technical panel of AUC	• " . . . the AUC are intended to evaluate overall patterns of care regarding revascularization rather than adjudicating specific cases . . . " • " . . . it is not anticipated that all physicians or facilities will have 100% of their revascularization procedures deemed appropriate . . . " • " . . . these criteria provide a framework for discussion and . . . .are not to diminish the difficulty or uncertainty of clinical decision making . . . " • "Ranking as uncertain . . . should not be viewed as excluding the use of revascularization for such patients . . . "
Technical limitations of AUC[16–18]	• Inadequate representation of interventional cardiologist in the AUC technical team (4 of 17) • Only 180 clinical scenarios assessed as against large number of clinical possibilities. For eg: PCI prior to transplant, TAVR, Staged PCI, PCI —CTO not well represented • Only six variables (fraught with limitations) considered while assessing scores • Doesn't consider patient comorbidities, patient choices, operator experiences, angiographic variables, institutional Heart-Team opinion, etc • Overdependence on Non-invasive ischemia testing (NIIT): Iinherent fallacies of NIIT like difficulties in assessing Duke Treadmill Score, subjective nature of NIIT assessment, role of vascular territory for not considered[21] • Metrics of Quality of Life not given due importance
Overall agreement of AUC score and ranking[19]	• About 73% and 70% concordance amongst cardiologist and AUC technical team on scenarios ranked as 'uncertain' and 'inappropriate' by the AUC. Upto 70% inter-physician non-agreement for scenarios ranked as 'inappropriate'
Results from few studies	• No correlation of mortality, morbidity, bleeding, medications on discharge with the hospitals proportion of 'inappropriate' PCI.[20] • FAME II trial showed benefit in elective PCI in patients with physiological significant lesions in patients with subclass III symptoms without a pre-procedure NIIT.[21] • No significant difference noted in clinical outcomes at 30d and 1 year with the implementation of AUC.[22,23]
Inadvertent effects of wide-spread publicity of AUC	• Reduced the importance of clinical judgement by the treating physician • Majorly viewed as a punitive tool to curb 'percieved' overuse of PCI • Used by payers to adjudicate a procedure instead of quality improvement for patient-car • Nomenclature 'uncertain' and 'inappropriate 'to be changed to 'may be appropriate' and 'rarely appropriate' in newer versions of AUC to avoid misinterpretation.

on totally occluded infarct related vessels (including the proximal LAD artery) more than 12 h after the index event. An equally large subset of patients (45% of the overall elective PCI ranked 'inappropriate') comprised of patients who underwent elective PCI for a one/two vessel disease (not involving the proximal LAD artery) with stable angina, CCS class II symptoms, low-risk findings on NIIT and sub-maximal anti-angina therapy. Thereby, in our study these two scenarios comprise almost all the 'inappropriate' PCI.

6.4. Year-wise temporal trends

Multiple recent landmark trials have influenced the clinical decisions on elective PCI. There is a recent trend in offering an up-titration of anti-angina therapy and NIIT prior to elective PCI.[11–13] Eligibility of multiple public and private-sector hospitals to perform PCI reimbursable under the GHIS had lead to significant streamlining of waiting lists in government hospitals. The rapid processing of documents and prompt sanction of funds under the GHIS has further encouraged the reduction in delay in seeking coronary care. This study is not powered to understand the actual trends in PCI because it considers only patients who actually underwent elective PCI during the study period and not those were prescribed PCI after a CAG. In this study, the year-wise temporal trends show no significant trends in any subset of PCI appropriateness (Fig. 3).

6.5. Comparison with other studies

While the term 'inappropriate' suggests non-reasonable strategy in this setting, it is not a value judgement about an individual or institution. Rather, it is a measure of how a well-matched control undergoing the procedure would have performed based on the available understanding of disease management. Similarly, it is also important to realise that the AUC are not without limitations elaborated in Table 3. Therefore, it is imperative that the AUC evolve as a tool to improve patient care and encourage optimal patient selection rather than a yardstick to assess institutional performance and govern reimbursement policy.

We acknowledge that there continues to remain a significant patient population admitted with ACS not only at our hospital during the study period but also all over the country, who may have never underwent diagnostic catheterization or subsequent revascularization. The significance of AUC is thus 'dwarfed' by the overall under-availability and economical hassles during revascularization. In the Indian scenario, these factors play a more important role rather than the perceived over-utilization of PCI.

Desai et al[8] in their study evidently showed that the number of 'inappropriate' PCI procedures dropped by 50% from 2009 to 2014. However, the average figures still hovered around 13% by the end of 2014 with rates lower than 6% at the best performing hospitals. Sood et al. in their analysis concluded that about 3.65% of randomly selected coronary revascularization procedures (including both PCI and surgical bypass grafting) under the GHIS of the state of Karnataka, India were deemed 'inappropriate'.[14] However, this study considered data submitted to the Payer-Provider Healthcare Database at pre-authorization for sanction of funds. Chan et al. concluded that in the non-ACS setting, there were 50.4%, 38.0% and 11.6% of PCI deemed appropriate, uncertain and inappropriate respectively by applying the 2009 AUC criteria.[15]

7. Future directions

The actual significance of PCI with 'uncertain' appropriateness remains largely unknown. A long-term follow-up of PCI with 'uncertain' appropriateness is therefore needed. The AUC,

primarily developed for the western world, remain to be tested in the Indian scenario. Notwithstanding, identifying organizational strategies that could lower the rates of 'inappropriate' PCI remain a potential area for further research. With only 10.15% of elective PCI in the non- ACS setting being offered a NIIT and almost all receiving sub-maximal anti-angina therapy, there is a lot of scope for improvement in the non-ACS group. Also, unless compelling indications exist, PCI of a totally occluded infarct related artery beyond 24 h should be strongly discouraged.

8. Limitations

The authors acknowledge certain limitations of this study. Firstly, it is a single centre, retrospective analysis with a relatively small study population and therefore, the findings cannot be easily generalised. However, it represents the largest data from Western India. Secondly, the veracity of these results also depends upon the analysis of the chest pain symptoms, recording of findings and prescriptions by the then treating physician. There was no access to the patient and angiographic films to verify the information independently. We cannot exclude the possibility of intentional up-coding of the subjective elements such as assessment of angina class. Lastly, there is no long term follow-up of patients in our study to further assess the extent of benefit for patients with varied appropriateness of PCI.

9. Conclusion

On applying the 2012 updated AUC, about 5% of overall elective PCI were deemed as 'inappropriate'. About four in every five elective PCI in the non-ACS setting were of 'uncertain' appropriateness due to significant underutilization of non-invasive ischemia testing. The implementation of the GHIS not only significantly reduced the gender bias and delay in seeking interventional coronary care but also led to a significant rise in the proportion of PCI performed in the ACS setting. However, there was also a rise in 'inappropriate' PCI in the ACS setting and a significant fall in 'appropriate' PCI in the non-ACS setting after introduction of the GHIS.

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